J. Perinat. Med.
10 (1982) 17

The monitoring of labor by telemetry

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1 Introduction

It has been a practice in Finland and many other countries to keep women in the supine position during labor and especially during the second half of the first stage. After rupture of the fetal membranes and during internal fetal heart rate monitoring, patients are attached to the bed, and electrical wires and infusion lines are connected to them. However, the upright position has been claimed to be physiologically superior to the recumbent position [8], based partly on clinical observations and partly on labor practices among primitive peoples. On the other hand, fetal monitoring considerably increases the safety of the fetus even in mothers not considered to be high-risk parturients [4]. Telemetry was introduced into biomedical use over ten years ago [1, 2, 6] and has been studied and improved thereafter by many groups [5, 9, 12, 13]. It has recently been reported that the length of labor has been shortened [3] and less analgesics required [3, 11] in mothers monitored by telemetric cardiotocography.

Fetal heart rate and uterine contractions can be reliably transferred by a telemetric system to a conventional cardiotocograph [7, 10, 11], allowing the mother to choose her position freely. **The present study was designed to determine the duration of labor and need of analgesia in normal parturients monitored by telemetry.** The second purpose was to study the safety of telemetry during the upright position after ruptured fetal membranes.

Curriculum vitae

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2 Materials and methods

The 60 study subjects were healthy patients with an uneventful pregnancy. Delivery took place between the 38th and the 42nd weeks of pregnancy and the age and duration of pregnancy of the patients were similar (Tab. I). The patients were matched for age (± 5 years), parity (I or II para)

Tab. I: Study patients.

	Parity	n	Age mean ± SD	Duration of pregnancy weeks, mean ± SD
Telemetry	I	13	26.8 ± 3.5	39.5 ± 1.1
Telemetry	II	18	29.9 ± 4.0	40.7 ± 0.6
Cardiotocography	I	12	26.8 ± 3.9	40.2 ± 1.3
Cardiotocography	II	17	29.4 ± 3.5	40.0 ± 0.8

0300-5577/82/0010-0002$02.00

and duration of pregnancy (± 1 week). After matching, **the telemetry method of cardiotocography was allocated at random to one or other of the patients.** The others were monitored by a conventional cardiotocographic method. Fetal heart rate (FHR) was monitored in both groups via a scalp electrode and the uterine contractions by an external tocodynamometer. Thirty one patients were monitored by telemetry and twenty nine by conventional cardiotocography. Matched control patients were not found within two days for two of the telemetric patients. The husband attended labor and delivery in 42% (13/31) of the cases in the telemetry group and in 59% of the cases (17/29) in the cardiotocography group. Induction of labor by amniotomy was performed in 32% (10/31) of cases in the telemetry group and in 24% of cases (7/29) in the control group. The HEWLETT PACKARD telemetry system (HEWLETT PACKARD 80210 A Obstetrical Telemetry System) was used. Internal fetal monitoring and telemetry was begun after spontaneous or artificial rupture of the fetal membranes at a stage when the cervix was 2–4 cm dilated. The patients monitored subjective pain every half hour by grading labor pain from 0 to 10. Zero meant no pain; numbers from 1 to 5 week to moderate pain; 6 to 7 severe pain; and 8 to 10 very severe or intolerable pain. Patients with the telemetry apparatus were encouraged to sit or walk during the opening phase. Nitrous oxide-oxygen, pethidin or epidural block were used for analgesia when needed. Two hours after delivery the patients filled a questionnaire about their subjective opinion of pain in the different stages of labor. The clinical events and use of analgesia were carefully monitored during labor. In the statistical calculations, Student's test and the chi square test were used.

3 Results

No maternal or fetal complications occurred. A pH and acid-base analysis of the fetal scalp capillary blood was measured in one case in the telemetry group and in four cases in the control group. With the exception of mainly physiological early decelerations, which occurred for variable periods in 36% of cases (11/31) in the telemetry group and in 24% (7/29) in the control group, only occasional short periods of fetal tachycardia or decreased variability in 7 of the 60 patients were observed. These FHR changes were considered normal. One patient in both groups had a few late decelerations which however did not lead to any operative procedures. The one and five minute APGAR scores were $\geqslant 7$ in all infants. The weights of the 60 children varied between 2860–4620 g. There were four vacuum extractions in the telemetry group, two vacuum extractions, one forceps delivery and two cesarean sections in the cardiotocography group. The indications were maternal or uterine exhaustion and inertia, except in two cases in the control group where fetal asphyxia was suspected because of FHR changes during the second stage of labor. The amount of blood loss in the third stage or labor did not differ significantly between the patient groups. One puerperal endometritis in the telemetry group and one urinary tract infection in a control subject was found. Two patients in both groups had low puerperal haemoglobin values and one in each group was given a transfusion of packed red blood cells.

The duration of the first stage of labour in the telemetry and the cardiotocography groups did not differ significantly (Tab. II). As expected, labor was shorter in the multiparous than the primiparous patients in both groups. The time needed for the dilatation of the cervix from 3 ± 1 cm to 10 cm was shorter in the second-paras monitored by telemetry than in the controls. This time was shortest, 212 ± 80 min (n = 13) in the telemetrically monitored secondparas who were actively in the upright position. However, even this difference was not significant. **The time spent**

Tab. II. Duration of labor.

	Parity	First stage of labor h, mean ± SD	Cervical opening from 3 ±1 to 10 cm min, mean ± SD
Telemetry	I	10.2 ± 5.4	369 ± 158
Telemetry	II	5.6 ± 3.8	225 ± 106
Cardiotocography	I	8.9 ± 4.6	267 ± 103
Cardiotocography	II	6.6 ± 4.1	263 ± 120

Tab. III. Use of analgesia during labor.

	Parity	Pethidin 75 mg		Nitrous oxide		Epidural block	
		n	%	n	%	n	%
Telemetry	I	11/13	85	9/13	69	3/13	23
Telemetry	II	5/18	28	11/18	61	0	0
Cardiotocography	I	12/12	100	9/12	75	3/12	25
Cardiotocography	II	9/17	53	12/17	71	2/17	12

in the upright position varied from 10% to 90% of the time. Four of the primparas and two of the secondparas in the telemetry group refused to get up from the bed. The evident reason was exhaustion due to pain.

The use of analgesia is shown in Tab. III. The usual dose of pethidin was 75 mg given once or twice during labor. A nitrous oxide/oxygen mixture was inhaled for various lengths of times and even a short half hour use was registered. Epidural analgesia had to be given to three primiparas in the telemetry group and to five control subjects because of severe pain. **The telemetry patients received less analgesics** than the controls, the secondparas particularly in the telemetry group receiving quite small amounts of analgesia. Oxytocin was given when needed by intravenous infusion. During the opening phase, 65% (20/31) of the telemetry patients and 66% (19/29) of the control patients were given oxytocin, lasting varying times.

The results concerning labor pain experienced by the patients are shown in Tab. IV. In the telemetrically monitored secondparas the distribution of figures which represents different degrees of labor pain was significantly different than in the controls. Among primiparous patients this distribution was even and did not differ significantly between the telemetric and control patients. **Thus the secondparas in the telemetry group experienced significantly less labor pain** than the conventionally monitored patients.

In general the patients seemed to like the telemetry method. However, although most patients found it helpful to be able to walk during the first half, **most preferred the lying position during the second half of the opening phase.** The evaluation of labor pain by the secondparous patients in the previous and present labor is shown in Tab. V. The telemetry patients considered the present labor less painful significantly more often than the controls ($\chi^2 = 6.59$, $p < 0.05$).

Tab. IV. The distribution of figures representing different degrees of pain experienced by the primiparas (A) and secondparas (B). The distribution between the telemetry and the cardiotocography group of the secondparas was different and statistically significant when analyzed by the chi square test ($\chi^2 = 11.54$, $p < 0.01$). The distribution of pain figures of the primiparous patients did not differ significantly. The values reported by patients given epidural block were excluded from the material.

A. I-p	Weak and moderate pain	Severe pain	Very severe and intolerable pain	Total
	0–5	6–7	8–10	
Telemetry	30	25	29	84
Cardiotocography	24	29	24	77
B. II-p	**0–5**	**6–7**	**8–10**	**Total**
Telemetry	51	21	8	80
Cardiotocography	37	26	25	88

Tab. V. Comparison of pain in the previous and the present labor.

	Less painful	No difference	More painful	Total
Telemetry patients	10	5	2	17
Cardiotocography patients	3	3	7	13

$\chi^2 = 6.59$, D.F. = 2, $p < 0.05$

4 Discussion

Application of radiotelemetry to fetal heart rate monitoring was described years ago [1, 2, 6]. However, most earlier reports on telemetry have been technical studies [5, 7, 9, 10, 12] whereas only few clinical reports exist [3, 11]. Ambulatory telemetric FHR monitoring has been claimed to have several advantages. It has been reported that the length of labor is shorter [3] although this was not found in the present and another previous study which included mostly primiparous patients [11]. **The reduced need for analgesics was a common result of the previous [3, 11] and the present study.** Whether it is due to a real reduced need or only reflects the attitudes of the patients and the medical personnel is open to speculation. In the present study the patients themselves monitored pain during labor and the results from the secondparas but not the primiparas showed that telemetrically monitored patients experienced significantly less pain than controls. This result is backed by the fact that less analgesics were needed by the telemetry group. The upright position thus seems to have a positive effect in reducing labor pain in secondparas. We have the impression that patients monitored by the telemetry apparatus should be encouraged to get up from the bed. The patients tend to stay in the labor bed because they have been taught that it is customary to be in bed during labor. According to the present results, **telemetry is safe for both the mother and child.** It has been claimed that fetal distress can be reduced by telemetry [3]. The infants of the present material were healthy at birth in both the telemetry group as well as in the control group. The patients monitored by telemetry were able to walk to the toilet several times during labor. Interestingly, this caused no changes in the FHR patterns. **Another advantage of telemetry is continuous FHR monitoring during the preparation and moving of the patient for cesarean section.**

Summary

Telemetry and conventional cardiotocography were compared by monitoring the labor of 60 patients with an uneventful pregnancy and delivery in the 38th–42nd week of pregnancy. 31 patients were monitored by telemetry and 29 by cardiotocography. The patients were matched for age (± 5 years), duration of pregnancy (± 7 days) and parity (I or II). The husband attended labor and delivery in 42% of the cases in the telemetry group and in 59% of the cases in the control group. Induction of labor by amniotomy was performed in 32% of the cases in the telemetry group and in 24% of the cases in the cardiotocography group. The patients monitored subjective pain every half hour during the opening phase. The telemetric patients were encouraged to sit or walk during the first stage.

No maternal or fetal complications occurred. All infants were born in good condition with APGAR scores ⩾ 7 recorded at one and five minutes. There were 4 operative deliveries in the telemetry group and 5 in the control group. Indications for these were maternal or uterine exhaustion with the exception of two control patients where fetal asphyxia was suspected. **The duration of the first stage of labor did not differ significantly** between the telemetry and the cardiotocography groups. **The telemetric patients received less analgesics** than the controls but this difference was not significant. In spite of less analgesia in the telemetry group, **the secondparas of the telemetry group experienced significantly less ($p < 0.01$) labor pain** than the controls. In addition, the secondparas of the telemetry group considered the present labor less painful than the previous one significantly more often than the controls. Among the primiparous patients there was no difference in the amount of pain experienced by the patients.

Keywords: Monitoring of labor, telemetry.

Zusammenfassung

Telemetrie in der Geburtsüberwachung

Wir wollten in unserer Untersuchung **die konventionelle cardiotokografische Geburtsüberwachung vergleichen mit einer telemetrischen Überwachung.** Das Kollektiv bestand aus 60 Patientinnen, die eine unkomplizierte Schwangerschaft hinter sich hatten und zwischen der 38. und 42. Schwangerschaftswoche zur Entbindung kamen. Wir bildeten Gruppen bezogen auf das Alter (± 5 Jahre), die Schwangerschaftsdauer (± 7 Tage) und die Anzahl der Schwangerschaften (I oder II). In der Telemetrie-Gruppe war der Ehemann in 42% der Fälle bei der Geburt anwesend, in der Kontrollgruppe in 59% der Fälle. In der Telemetrie-Gruppe wurde bei 32% der Patientinnen eine Blasensprengung durchgeführt, in der Cardiotokografie-Gruppe bei 24%. Die Patientinnen sollten während der Eröffnungsphase jede halbe Stunde ihre subjektive

Schmerzempfindung schildern. Wir hielten die mittels der Telemetrie überwachten Patientinnen dazu an, während der ersten Phase zu sitzen oder herumzulaufen.
Weder von Seiten der Mütter noch von Seiten der Feten traten Komplikationen auf. Alle Kinder waren in gutem Zustand und hatten einen APGAR-Score ⩾ 7 eine bzw. fünf Minuten post partum. In der Telemetrie-Gruppe kam es zu 4, in der Kontrollgruppe zu 5 operativen Entbindungen, wobei die Indikation meistens durch Erschöpfungszustände der Mutter gestellt wurde. Lediglich in 2 Fällen aus der Kontrollgruppe bestand der Verdacht auf eine fetale Asphyxie. **Hinsichtlich der Dauer der Eröffnungsphase gab es zwischen den beiden Gruppen keine signifikanten Unterschiede. Die Zweitgebärenden aus der Telemetriegruppe gaben nicht soviel Schmerzen wie die entsprechenden Frauen aus der Kontrollgruppe an ($p < 0.01$), obwohl sie weniger Analgetika erhalten hatten.** Weiterhin gaben die Zweitgebärenden aus der Telemetrie signifikant häufiger als die Kontrollgruppe an, daß der jetzige Geburtsverlauf nicht so schmerzvoll sei wie der vorausgegangene. Unter den Erstgebärenden ließen sich bezüglich der Schmerzempfindung keine Unterschiede feststellen.

Schlüsselwörter: Geburtsüberwachung, Telemetrie.

Résumé

Surveillance du travail par télémetrie
Les auteurs comparent la télémétrie et la cardiotocographie conventionnelle en surveillant le travail de 60 patientes avec une grossesse normale et un accouchement entre la 38ème et la 42ème semaines. 31 patientes ont été surveillées par télémétrie et 29 par cardiotocographie. Les patientes sont appareillées pour l'âge (± 5 ans), la durée de la grossesse (± 7 jours) et la parité (I ou II). Le mari assistait au travail et à l'accouchement dans 42% des cas du groupe avec télémétrie et dans 59% des cas du groupe témoin. Le travail a été déclenché par rupture des membranes dans 32% des cas du groupe avec télémétrie et dans 24% des cas du groupe témoin. La surveillance de la douleur subjective des patientes a été effectuée toutes les demi-heures pendant la période de dilatation. Les patientes surveillées par télémétrie étaient encouragées à s'asseoir ou à se promener pendant la première partie du travail.
On n'observa pas de complications maternelles ou foetales. Tous les enfants naquirent dans de bonnes conditions avec un APGAR ⩾ 7 à une et à 5 minutes. Il y eut 4 extractions instrumentales dans le groupe avec télémétrie et 5 dans le groupe témoin. Les indications de ces manoeuvres instrumentales furent l'épuisement maternel ou utérin à l'exception de 2 patientes du groupe témoin chez lesquelles une asphyxie foetale a été suspectée. **La durée de la première partie du travail n'a pas présenté de différence significative** entre les 2 groupes. **Les patientes avec télémétrie reçurent moins d'analgésie** mais cette différence n'est pas siginificative. Malgré cette moindre analgésie dans le groupe avec télémétrie, **les secondipares de ce groupe ressentirent moins de douleurs** pendant le travail que celles du groupe témoin ($p < 0{,}01$).
De plus, les secondipares du groupe avec télémétrie ont considéré le travail actuel comme moins douloureux que le précédent plus souvent et de façon significative que celles du groupe témoin. Parmi les primipares, il n'y eut pas de différence quant à l'intensité de la douleur ressentie par les patientes.

Mots-clés: Surveillance du travail, télémétrie.

Bibliography

[1] BAUMGARTEN, K., A. FRÖLICH, K. SOKOL: Kontinuierliche Herzfrequenzüberwachung des Kindes sub partu via telemetrische direkte Fetalelektrokardiographie. Wien. Klin. Wschr. 16 (1968) 307

[2] CACERES, C. A.: Biomedical telemetry. Academic Press, First Edition, New York–London 1965

[3] FLYNN, A. M., J. KELLY, G. HOLLINS, P. F. LYNCH: Ambulation in labour. Brit. Med. J. 2 (1978) 591

[4] HOBBINS, J. C., R. FREEMAN, J. T. QUEENAN: The fetal monitoring debate. Obstet. and Gynec. 54 (1979) 103

[5] KLAPHOLZ, H., K. SUZUKI: Evaluation of the model 78100A adult telemetry unit for use in fetal heart rate monitoring. J. Reprod. Med. 18 (1977) 79

[6] LEPAGE, F., C. SUREAU, J. CHAVINIÉ, M. CANNON: Quelques tentatives de télé-électrocardiographie foetale. Gyn. Obst. (Paris) 65 (1966)

[7] LIPSHITZ, J., J. E. WADE, G. D. ANDERSON, B. M. SIBAI: Evaluation of the Corometrics 315 telemetry system for fetal monitoring. Amer. J. Obstet. Gynec. 139 (1981) 199

[8] MÉNDEZ-BAUER, I. ARROYO, U. FREESE, C. GARCIA-RAMOS, P. HUNDSDORFER, F. IZQUIERDO, M. LAVILLA, J. MANAS, J. MARTINEZ, A. MENÉNDEZ, L. REINA, J. ROBERTS, A. RUIZ-CANSECO, A. STEINER, J. ZAMARRIEGO CRESPO: The dynamics of labor in different positions. 7th European Congress of Perinatal Medicine, September 2th–5th, 1980, Barcelona, Spain

[9] NEUMANN, M. R., J. PICCONNATTO, J. F. ROUX: A wireless radiotelemetry system for monitoring fetal heart rate and intrauterine pressure during labor and delivery. Gynecol. Invest. 1 (1970) 92

[10] NEUMAN, M. R., J. F. ROUX, J. E. PATRICK, M. G. MUNRO, D. W. GUDMORE, S. M. OWEN, E. ANGEL, H. E. FOX, D. PESSEL: Evaluation of fetal monitoring by telemetry. Obstet. and Gynec. 54 (1979) 249

[11] STEINER, H., D. ROBRECHT, H.-J. KRÜGER, E. COURTIN, H. G. HILLEMANNS: FHF und Wehenübertragung durch ein Zweikanal-Telemetrie-System. Geburtsh. Frauenheilk. 40 (1980) 876

[12] UNGER, F. W., J. W. GOODWIN: Instrumentation for fetal electrocardiography and intrauterine pressure – A new scalp electrode and radiotelemetry system. Amer. J. Obstet. Gynec. 112 (1972) 351

[13] WALKER, D., J. GRIMWADE, C. WOOD: The monitoring of foetal heart rate by radiotelemetry. Med. J. Aust. 2 (1970) 1078

Received June 16, 1981. Revised August 6, 1981. Accepted September 18, 1981.

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